EVOLUTION OF UNITED STATES MILITARY LANDMINE DOCTRINE AND EMPLOYMENT

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This study examines the development of the U.S. military's approach to landmine warfare, from its earliest beginnings in the first half of the 1800s to the modern era. It addresses both technological innovation, in response to new enemy tactics, as well as shifts in doctrine. Examining different eras, it explores the way soldiers improvised employment methods and leaders shifted doctrinal guidance. The study concludes that American landmine warfare grew in a haphazard manner, characterized by many discrete fits and starts, influenced directly by newly-encountered enemy tactics and styles of warfare. Technical development grew as soldiers adapted in the field; doctrine adapted as leaders attempted to incorporate their soldiers' innovations into written guidance, or to counter particularly troublesome enemy tactics. Further, landmines can be a great equalizer, allowing an outmatched belligerent to even the playing field against a larger or better-equipped one.

Landmines will not cease to be a factor in planning or execution of operations simply because they have fallen out of favor, or because a treaty has been signed banning their use. Many opponents, and several allies, will continue to employ them. Millions of them remain, armed and waiting, on battlefields all over the planet. The study of landmine warfare therefore remains relevant.

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ABSTRACT

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ACRONYMS

AP	Anti-Personnel
AT	Anti-Tank
BD	Bomb Disposal
LZ	Landing Zone
VC	Viet Cong
WAAPM	Wide-Area Antipersonnel Mine

CHAPTER 1

INTRODUCTION

Background and Importance

The U.S. Army's first phase of Explosive Ordnance Disposal School was once conducted at Redstone Arsenal, in Alabama. The sprawling base is also the birthplace of American rocketry. Buildings are named after the National Aeronautical and Space Administration forerunners like Werner von Braun and Holger Toftoy. Redstone continues as the place that many experimental weapon systems are tested before being put into the acquisitions pipeline. Students whisper about classified weapons testing going on at Redstone. Somewhere on Redstone, as one rumor goes, is a heavily fenced field inhabited by a cluster of mobile, self-aware landmines. They are powered by experimental solar tiles which gave them an endless power source.

Built with spider-like metal legs, they are able to move themselves. They use a rudimentary local wireless network to communicate with each other and form a sort of hive awareness. Each mine votes on where and when to relocate the mass. They can sense the destruction of a fellow mine as it drops out of the network. Their algorithms enable them to decide collectively on how best to rearrange the surviving mines to achieve maximum coverage of their assigned area.

Nobody can enter the test area, the story goes, because somebody had made a software error while programming the mines. Nobody can turn them off due to the error, and nobody is sure how many are left of the original test group. So there exists an uneasy standoff. The self-aware mines keep to their little fenced area, not more than a few

hundred meters square. The soldiers guarding the place keep out, just making sure the fence is maintained to prevent the mines from escaping.

This outlandish story is almost certainly untrue, but open-source research confirms that self-healing minefields were being developed at Fort Leonard Wood, Missouri, as early as 2003. The United States may be signatory to various treaties and as recently as 2014 has pledged to follow, in spirit, several others. Yet it continues to develop and test new landmine technology.

The continuation of refinement of banned weapons is not as uncommon as one might imagine. Bans on new weapons technology are frequent throughout history. Just as common is the abandonment of those prohibitions as soon as a sufficiently alarming threat emerges. Given a sufficiently existential threat, landmines may be quickly employed once again.

Pope Innocent II, and really the entire Second Lateran Council convened in 1139 A.D., prohibited the "murderous art of crossbowmen and archers, which is hateful to God."[1] Whether this prohibition was more political than religious has been debated for years, by historians, Catholics, and those falling into both camps. Some claim the relevant paragraph has been mistranslated. In any event, the use of crossbows and bows hardly diminished. Even the canon itself only forbade their use against "Christians and Catholics."[2] The Mamluks similarly banned the use of firearms in their army, claiming that they were not Godly. The Ottomans handily defeated them. Today few laymen have heard of the Mamluks.[3]

Prohibitions on particular weapons or weapon systems do not succeed in preventing their use, nor have they succeeded in eradicating them from existence.

Additionally they have not prevented developers from refining them. This refinement includes both improvement to technical mechanisms and refinement of the policies and doctrines governing their employment.

The continuing development of landmines by the United States is ironic given its reputation as the country that introduced the concept of a worldwide landmine ban. The United States is not signatory to the Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction introduced in Ottawa in 1997. (This treaty is also more informally, and succinctly, known as the Ottawa Treaty, the Landmine Treaty, or the Mine Ban Treaty.)

Although widely praised and supported, the treaty was not signed by many major powers, including the United States, China, and Russia. Many other nations, such as Israel, Korea, India and Pakistan refused to sign as well. These smaller countries believe that landmines are an integral part of their national security strategy.

The official U.S. position is that it still has valid military need for landmines, in particular for defense of the Republic of Korea (South Korea). The Landmine Treaty is also too broad in its prohibitions, argued President Clinton in 1998, in that it fails to make exceptions for smart mines which self-destruct or self-inert after a certain period of time.[4] Some of these have been in development for decades. U.S. policymakers are aware of the unpopularity of this position, and have also begun since the late 1990s to devote government resources to researching landmine alternatives. The Department of Defense has also conducted many humanitarian demining missions, often partnering with host-nation military personnel.

In a more recent development, the Obama administration announced in 2014 that the United States would henceforth comply with the Ottawa Treaty, even though the nation is not signatory to the treaty. The exception held back by the White House was that it would continue to maintain only those landmines required for the defense of South Korea. Statements from the Department of State implied that the obligation to defend the Republic of Korea was the only condition preventing the United States from signing the treaty.[5]

This recent development, however, is for the time being merely a policy shift. Until the United States signs the treaty, a policy initiative is only good until the next election. One might also argue that even a signed treaty is only good until a threat becomes existential. In that situation, a nation or its leaders may decide that preserving the nation takes precedence over complying with a treaty. For example, though the United States has signed many nuclear nonproliferation treaties, test bans, and other international agreements regarding nuclear warfare, it still studies nuclear warfare theory and philosophy.

In light of this, the study the development of landmine warfare is vital. The landmine is a relative newcomer to the battlefield, only making its first appearances in the 1800s. Not until World War II were landmines mass produced. Even then, the great powers had only sparingly considered lasting implications of mine warfare. By the time of the U.S. entry into that war, the number of official American military manuals regarding landmine warfare was next to nothing. What was written was frequently ignored or abandoned as conditions changed.

Warfare often both spurs and takes advantage of advances in technology. Rarely has a technological innovation in the realm of warfare seemed to create as much outcry as the landmine. From the Civil War to modern times, the lowly landmine has provoked much international debate and discussion. Due to its high level of passionate attention, and relative late arrival on the battlefield, official landmine doctrine and policy has experienced a rapid evolution. Many military thinkers and leaders understand the necessity of debate and consideration with regard to employment of a new or particularly loathed weapon system. Leaders considering future warfare should understand how and why U.S. military doctrine, policy, and employment of landmines evolved from their introduction into the American arsenal until the modern era.

As this study will show, the practice and doctrine of American landmine warfare grew in a manner that was haphazard. The U.S. military was very reluctant to embrace mines as a legitimate weapon system, and only infrequently modernized its written guidance. When it did devote time and resources to develop its landmine program, it was usually due to overwhelming necessity or even desperation. Landmines have had, from their very earliest uses in American conflicts, a reputation somewhere between repulsion and dread. This dread may have contributed to the unwillingness of American doctrine writers and unit commanders to use landmines, or even to sufficiently educate their troops on landmine warfare. As a result, the amount of American servicemembers lost to landmines was far higher than may have been necessary. The cure, so to speak, was so terrible that many were lost to the disease.

American landmine warfare therefore grew fitfully due to its repugnant nature and the dread it instilled in many military leaders. This willful avoidance did not, however,

safeguard American soldiers against mines. Indeed, in almost every conflict for which the data is available, landmines destroyed more vehicles than any other weapon system, including other vehicles, dismounted troops, or in some cases even maintenance issues. Disreputable though the subject was, its effectiveness directly led to landmine doctrine and technique being updated drastically as conflicts became serious. American ingenuity led to development of the earliest landmines, cobbled together from other weapons systems in the American Civil War and World War I. The desperate nature of the conflicts drove innovation in later engagements such as World War II, Korea, and even Vietnam. Indeed, though the Vietnam War is largely thought of in popular history as mostly a guerilla conflict, mines destroyed almost two- thirds of the vehicles in that theater.

From a run-of-the-mill noncombatant observer mission to the Crimean War, landmines came to the attention of an American Secretary of War (who later became the President of the Confederacy, on the opposing side of the officers he dispatched to observe the Crimean conflict). The formal doctrine was updated sporadically between this war and World War I, where American soldiers found themselves ill-prepared to deal with landmines, which were then generally slapdash devices intended to counter what was then the cutting-edge advent of armored vehicle warfare. During the interwar years, doctrine was updated a bit, but the United States still found itself unable to deal effectively with the landmine problem upon its entry into World War II. Quickly recognizing the vast experience of the British, however, America embraced landmine warfare and sent its soldiers to its ally's counter-mine schools. The American effort paid

dearly for its reluctance to fully address landmine warfare in World War II, as the casualty data showed—particularly with regard to vehicle kills.

In Korea, the enemy's swift advances led to the United States amending its policy on air-dropped landmines. The tactics of the enemy also drove innovation, the most evident of which was the Claymore directional fragmentation mine. This particular mine is still in use, in various iterations, today. In Vietnam, the toll taken by enemy landmines was so terrible that American commanders chose to abandon one of the crucial aspects of warfare: the element of surprise. American units began shelling helicopter landing zones prior to insertion, which alerted the enemy to exactly where American troops were about to land. They did this because of the fear of landing zones being mined. Once again, the dread of landmines drove a radical shift in established practice. In retrospect, one can hardly justify notifying the enemy about an intended landing site. At the time, however, it may have seemed prudent: during some reporting periods, landmines accounted for almost 80 percent of all vehicles destroyed in Vietnam.

U.S. policy and employment of landmines has evolved largely because of the enemy's actions. When on the offensive, as America prefers to be, the country devotes little energy to it. When on the defensive, it grows rapidly, although in unpredictable fits and starts. When the conflict becomes sufficiently desperate, the United States will use landmine warfare enthusiastically. The study of landmine warfare, therefore, should not be neglected. Landmines allow a weak belligerent to oppose a large one. In short, landmines allow David to fight Goliath. In case America ever finds itself the David in a conflict, the study of landmine employment and the refinement of landmine doctrine should be encouraged.

[1] Innocent II and Second Lateran Council, 1139 quoted in Norman P. Tanner, ed., *Decrees of the Ecumenical Councils,* 2 vols. (London: Sheed and Ward, 1990), 203.

[2] Ibid.

[3] Parker, Geoffrey, *The Cambridge Illustrated History of Warfare: The Triumph of the West* (Cambridge, England: Cambridge University Press, 2008), 367.

[4] Anne Theodore Briggs, "Proceed With Caution: U.S. Policy Toward a Global Ban on Landmines," *Human Rights Brief* 6, no. 3 (1999): 9-10.

[5] Associated Press, "Obama Administration Creates Korean Land Mine Exception," *Washington Times*, September 23, 2014, accessed November 13, 2014, http://www.washingtontimes.com/news/2014/sep/23/obama-admin-creates-korean-land-mine-exception/.

CHAPTER 2

FALSE DAWNS

Very Early Brief History to World War I

The modern landmine is the product of the intermarrying of two great families of military weaponry and tactics. The first is the practice of digging a tunnel under an enemy's defenses—literally, mining it. The usual intent with mining was to collapse the enemy's wall or to detonate an explosive beneath it, obliterating it. In either case, the attackers could then breach the defenses through the opening and hopefully expand and exploit the salient.

This practice has been used for thousands of years, and it may be impossible to pinpoint the earliest use. An Assyrian orthostat in the British Museum in London depicts a city under siege. Illustrated are siege engines, soldiers on assault ladders climbing over the wall, and a team of soldiers mining beneath it. This particular orthostat dates from at least 859 B.C.[1]

The second family from which the landmine descends is that of devices which ancient armies used to hinder and wound the enemy. This was a diverse group of devices which could make an area defensible by a smaller force against a larger one by denying the attacker access to the full range of the defenses. It includes caltrops, pits with sharpened stakes, and a wide range of other anti-mobility implements.

Another such area denial device was the caltrop. A caltrop was made up of four spikes, arranged much like a child's jack so that one spike always pointed upward. They were made of metal, usually iron, and could be scattered quickly into grass or loose soil in the assumed path of the enemy. Once the enemy army began its charge, it could

quickly fall into chaos as soldiers impaled their feet on the unseen caltrops. Falling forward in agony, they would further wound themselves.[2]

History is full of accounts of sieges and battles wherein armies used these weapons against each other. In 52 B.C., Caesar besieged the Gallic town of Alesia—and was almost immediately besieged himself, by a Gallic army which had come to relieve the garrison. Facing enemies both within and outside his ring, he had his soldiers saturate the defenses on both sides with area denial devices. They made pits with sharpened stakes, which the soldiers nicknamed lilies or lily pits. Blocks of wood with hooked iron rods projecting from them were called goads. Another simple system of sharpened tree branches jammed into the ground in dense arrays were called boundary posts. Caesar cleverly directed that safe lanes through the obstacles be kept clear to allow him to sally either inward or outward depending on which enemy group he chose to strike. Due to his defenses and also to his tactical acumen, Caesar not only conquered the town of Alesia but smashed the relieving Gallic army, a total of over 330,000 men. Caesar had only 70,000 Roman soldiers when the siege began.[3] These anti-mobility devices allowed the Romans to soundly defeat a force almost five times larger.

Caltrops have been used for millennia. They have been excavated from battlefields dating as early as the 400s B.C. and there are accounts of Alexander the Great using them on his campaigns during the 200s B.C. Like the Roman lily pits outlined above, caltrops never really fell out of use. The residue of this type of warfare could cause deleterious effects on civilians as well. Francis Markan, a Hungarian Catholic monk, noted this when he complained that “the foards are soon choakt up with caltrops,”

rendering their use dangerous long after the war was concluded.[4] Though he was writing in 1622, his words are eerily similar to those of anti-mine activists in modern times.[5]

The two families—the use of gunpowder mining and area denial—first joined with the advent of the fougasse. Reportedly used in China as early as the twelfth century A.D., the fougasse was a pit filled with gravel and debris over a gunpowder charge. When the enemy advanced before the pit, the defender would ignite the charge, showering the area. Unlike a cannon, the fougasse could not be reloaded during the battle. Its utility was in its concealment, and it was usually a one-shot affair. Another problem was the high hygroscopicity (moisture absorption rate) of the black powder fuses used to initiate the fougasse. Called powder hoses, these often absorbed too much water before the enemy had advanced into the kill zone, leading to misfires.

The fougasse was used for centuries, but counterintuitively, its use did not lead directly to development of early modern landmines. The development of sea mines led military thinkers to consider modifying them to be used on land. Sea mine development was spurred in part by the American use of primitive sea mines against British ships during the Revolutionary War.[6] Although the attack failed to cause much damage, British naval officers were aware of the implications of this new technology. Their excited reports about the attack spurred much interest in sea mine development back in Europe.

After the Revolutionary War, Americans continued to develop weapons technology as well. In the 1790s, Robert Fulton developed a series of torpedoes, which he likely named after the stingray called the torpedo ray. These explosive devices were mechanically-fired. Fulton also developed an early submarine prototype. Unfortunately for Fulton, his samples failed several high-profile proof of concept demonstrations in

1807. Though he continued to publish and develop, his reputation never recovered. However, some torpedoes similar to his designs were used against the British during the War of 1812.[7]

Some of these early technological innovators are famous even today. No less than Samuel Colt himself gave what may have been one of the earliest demonstrations of an electrically-fired torpedo in 1842. Several more followed.[8] While the United States chose not to buy any of his designs, interest in electrically-fired torpedoes grew due to the success of his demonstrations.

Another early innovator was West Point instructor Dennis Hart Mahan, who compiled another candidate for the first doctrinal framework for mine warfare. His *Complete Treatise on Field Fortification* outlined proper employment of the fougasse. Published in 1836, the *Treatise* was used until at least the 1870s.[9]

At this point in history, sea mines were called torpedoes, despite the fact that they had no means of propulsion as many envision modern torpedoes. The name was attached to landmines as well as they grew more common and powerful. This nomenclature continued for quite some time, and as late as the early 1900s some manuals refer to landmines as torpedoes. General George McClellan bemoaned the use of torpedoes. In this context he meant artillery shells rigged to make rudimentary landmines, by the Confederates against his advancing troops.[10] So it is important to remember that landmines were called torpedoes quite commonly for much of their history.

Gabriel Rains, who would later become a brigadier general in the Confederate Army, could be called the father of modern mine warfare. Rains used the term “subterras,” “subterra torpedoes,” or “subterra mines” to describe the mines he used

during the Seminole Wars to defend Fort King in the Florida wilderness in 1839.[11] Under siege by Seminoles, Rains buried a shell in the ground outside the fort and covered it with soldiers' gear. The clothing was attached to a modified fuse which would ignite the shell when removed, ostensibly by thieving Seminoles. However, a possum apparently detonated the device before the Seminoles could do so. Although grievously wounded in a fight soon afterward, Rains' innovative use of the shells earned him a promotion to major and some acclaim. He also earned the enmity of some who considered this type of warfare ungentlemanly. Years later during the Civil War, Rains would direct the use of landmines to delay Union forces pursuing Confederates retreating from Yorktown.[12]

Though it earned him a promotion, Rains apparently made no improvements or efforts to further develop landmines between the Seminole and Civil Wars. Indeed, few Americans at all devoted much thought to the subject; however, there were a few exceptions.

The aforementioned Samuel Colt demonstrations proved that electricity could be used to detonate torpedoes, and it was a small logical leap to apply this technique to landmines as well. Though Colt's torpedoes were not purchased by the government, they still inspired much debate and thought among warfare thinkers. Advice on the electrical firing technique was incorporated for the first time into official U.S. military manuals and doctrine. One of these was Henry Wagner Halleck's *Elements of Military Art and Science*.[13] The manual contained a section on how to wire and initiate chamber mines using galvanic batteries. Chamber mines were intended to reduce earthworks and walls, but the elements were all there for the next developmental step.[14]

Word of the technique was spreading, and innovative soldiers were refining its use. Reports from the First Schleswig War in 1848 contained accounts of mine warfare using torpedoes exploded electrically to strike the Dutch fleet at Kiel. In the 1850s the Spanish developed a technique for detonating multiple chamber mines using galvanic batteries and elaborate (for that era) circuitry systems. This allowed initiation of many mines at once from a single firing point.[15]

The U.S. military also engaged in the time-honored practice of sending observers to analyze and report firsthand from foreign fields of battle. In 1855. Secretary of War Jefferson Davis sent three observers to the Crimean War. These included: Major Richard Delafield, an engineer; Major Alfred Mordecai, an ordnance officer; and Captain George B. McClellan, a cavalry officer. Davis and McClellan would, of course, soon end up on different sides of the American Civil War. The delegation observed the siege of Sevastopol and wrote detailed reports on tactics and technologies. Delafield in particular was very interested in mine warfare and recommended a fuller use by the American military of torpedoes, both sea and land varieties. He was also impressed by the new mine fuses used by the Russians which had been developed by Alfred Nobel (although he mistakenly attributed them to another inventor). Delafield included several detailed sketches of the mines in his report to Davis and the Congress.[16]

McClellan, a cavalryman, paid little attention to the use of mines. Mordecai was an ordnance officer but was confined to camp for much of the delegation's visit due to a severe illness. The only other officer of note whose interest in mine warfare was piqued by the Crimean War reports was young First Lieutenant James St. Clair Morton. He worried that the American militia would be ill-prepared to repel European invaders, and

so recommended the use of sea mines, landmines and fougasse. He suggested the use of harbor torpedoes and other naval defenses. For land warfare, Morton suggested cheap, quick earthworks and "the use of fougasse and mines."[17]

Unfortunately for Morton, and for the Union Army, Morton's superiors did not take his ideas very seriously. Although he rose to the rank of Chief Engineer to the Armies of the Ohio and Cumberland, the traditionalist senior officers never fully accepted his advocacy of landmine warfare. Morton died at Petersburg, apparently from a stray or sniper's bullet, while laying out Union defenses.[18]

Also unfortunate for the Union Army was the ready acceptance of mine warfare on the opposite side. Perhaps this was due to the general acceptance at the time of landmines as defensive weaponry, with the Confederate Army often fighting defensively. Moreover, Secretary of War Jefferson Davis, who had sent the Crimean delegation only a few years prior, became the President of the Confederate States of America. Unlike Union officers and leaders, the reports of landmine use during the Crimean War had caught his interest. Gabriel Rains, the innovator who had first used subterras all those years earlier during the Seminole War, chose to fight for the Confederacy as well. In Rains and Davis there was a kind of artist-benefactor relationship. The lessons of landmine warfare drawn in the decades prior would be used most effectively by the Confederates, much to Union consternation.

Though landmine warfare would grow in new directions during the American Civil War, it began as an unremarkable tactic in the beginning. This was due to its close relation to sea mine and sea torpedo development, which was practiced and developed by both sides during the war. Landmine warfare was also uncontroversial in the early stages

of the war because neither side was using landmines, land torpedoes, or fougasse, or any variation thereof, in anything but defensive operations. The Civil War changed that. Landmines became not a supplement to the defensive, something to place in front of one's fortifications, but an offensive weapon. This new employment technique caused the first debate about landmine use, a debate which still rages hotly today.[19]

In 1861, Confederate President Jefferson Davis recommended Gabriel Rains for induction into the Confederate Army. No doubt Davis was drawing on his interest in mine warfare sparked by the Crimean War delegation on 1855. He also likely remembered Rains' creative use of modified artillery shells as landmines during the Seminole War. Oddly enough, Rains' first employment of landmines as a Confederate was against a force led by George McClellan, who had been part of the Crimean War delegation. The setting was Yorktown, from which Confederate forces were retreating. He mined the defensive works around the city using mortar shells armed with fuzes of Rains' own design, placed visibly at access points and likely avenues of approach in front of the earthworks.

These mines were used in the standard defensive fashion, but soon Rains adapted them for another purpose. Rains' goal was to delay the pursuing Union forces long enough to allow the Confederates to escape unharmed. In true McClellan fashion, he delayed seizing the town until he had absolutely overwhelming force. The Confederates, observing the Union forces finally moving their siege guns into position took advantage of darkness to slip out of town on the night of May 3, 1862. Behind them they left torpedoes to hinder their Union attackers. These mines were artillery shells buried with jury-rigged fuzes jutting just above the earth, to be detonated when disturbed. The fuzes

were friction type, apparently designed by Rains himself and hooked to lengths of telegraph wire. When fouled by man or horse, these wires would pull the friction igniters, detonating the mines.[20]

Notably—for the first time in American history—Rains purposely emplaced his mines in a deceitful fashion which might be called offensive, or at least deceitful, rather than defensive in nature. Rains abandoned the practice of only mining defended earthworks and maintaining visual oversight on them. He mined woodpiles, telegraph poles, wells, and other places that tired advancing troops were likely to congregate. His method gained much attention from other officers, many of whom considered the offensive use of landmines repulsive or at least ungentlemanly. Emplacing landmines defensively, in earthworks or avenues of approach, in order to prevent or delay an attack or pursuit, was acceptable. The practice of emplacing them hidden, to wound or kill an unsuspecting enemy, was "barbarism."[21]

McClellan immediately denounced Rains' use of landmines at Yorktown, calling it a "most murderous and barbarous conduct" in a letter to Secretary of State Edwin Stanton, and began forcing Confederate prisoners of war to search for or disarm them.[22] McClellan may have been speaking out of passion, for he had lost 30 men to the torpedoes when they entered the abandoned Yorktown and attempted to pursue the retreating Confederates. William T. Sherman also began the practice of forcing prisoners of war to conduct search or disarming activities. Sherman later appeared to soften his views. "I now decide that the use of the torpedo is justifiable in war in the advance of an army so as to make his advance up a river or over a road more dangerous," he wrote several years later.[23]

Union Brigadier General William Barry, outraged, engaged in some hindsight condemnation of Rains' use of subterras in the defense of Fort King, decades earlier during the Seminole Wars. He claimed Rains had "disgrace[ed] the uniform of the American Army in the Seminole War in Florida" through his use of mines.[24] Berry waited until after Yorktown in 1862 to voice this opinion.[25]

Rains even made enemies on his own side for his innovative application of mines. Major General James Longstreet was so opposed to this use that he preferred to use an intermediary, Brigadier General Moxley Sorrel, to convey his displeasure to Rains. Such use of torpedoes was not "proper or effective."[26] Additionally, Sorrel snootily told Rains that if he would "put them [the subterras] aside and pay some attention to his brigade his march would be better and his stragglers not so numerous."[27]

Rains' methods were eventually accepted by most of his peers after Secretary of War G.W. Randolph supported them. Rains wrote a book on the subject for President Davis which seems to have been the earliest document approaching a formal written doctrine for landmine use by an American army. Unfortunately, it did not survive the war, and all that is left are remarks in notes, correspondence, and official records.[28] The Confederacy established a Torpedo Bureau in 1862 in order to develop mines and keep records of experiments, but it suffered a catastrophic fire near the end of the war, destroying nearly all documents. In his book *Infernal Machines: The Story of Confederate Submarine and Mine Warfare,* Milton F. Perry implies that he believes the fire was set deliberately.[29] Fortunately, many private letters and notes survive today, including the manuscript of another book Rains meant to publish later (*Torpedo Book*), and it is therefore possible to put together a vague notion of a doctrine, at least on the

Confederate side. Landmines used in traditional defensive manner was acceptable. Landmines as used at Yorktown and other actions—torpedoes, subterras or booby traps—gradually came to be accepted as well, and by the end of the war, Confederates had used them in most campaigns. Rains also devised methods of marking minefields and arranging lanes through them for traversal by friendly forces. These included colored flags which could be pulled up shortly before an enemy approach, or lanterns covered on the enemy side in low-light conditions.[30]

Other innovations were the advent of a fuze cap, made of copper or some other metal, which could be screwed over the fuze of a mine and removed at the last minute, to lessen the chance of accidental detonation. There were several variations of this. The Confederates were also developing the first American command detonated mines. These are devices which are emplaced and then detonated at will by a watcher, in order to provide more discernment in target selection. Colonel William Lamb, defending Fort Fisher in North Carolina against a Union assault, had his men place modified sea mines (really little more than copper drums filled with powder) in front of the works, and wired them to detonators inside the fort. When the Union forces under Major General Benjamin Butler landed, they were forced to retreat due to these "subterran torpedoes" despite numerical majority.[31] Indeed, the second assault may have only succeeded because the mines' wiring had been cut by another heavy bombardment.

The Union Army was also conducting research into and testing landmines during this time. Subterra mines, apparently copied whole cloth from the Rains version, appeared in small numbers as early as mid-1864. The Union also had railroad mines in their arsenal, charges laid underneath rails which were pressure-activated by the weight

of passing trains. However, as stated above, by this time, the Union was nowhere on the defensive. There does not appear to be a formal doctrine on landmine warfare on the Federal side during the Civil War, although the *Official Records* do document many incidents of their use or discovery.[32]

The American Civil War was the first war which illuminated the dissonance between popular thought about landmines—i.e., ungentlemanly, barbaric, etcetera—and the willingness to use them anyway if the fight became sufficiently desperate. This is illustrated by the failure of Longstreet and others to permanently damage the career of Gabriel Rains. There is no evidence that the victorious North ever sought to prosecute Rains and other Confederate landmine advocates for any crimes, and even Sherman came to view the weapons as acceptable as mentioned previously.

There was little formal doctrine on landmine use on either side during the Civil War, although what little there was existed on the Confederate side. There were, however, numerous examples of personal correspondence between senior officers which indicate an informal doctrine, namely, that landmines should be used to support a prepared defense or to delay pursuit. They should never be employed in a duplicitous manner, for example as booby traps. Despite the increased attention landmines gained during the war, the decades afterward oddly failed to produce much in the way of formal doctrine. What little doctrine existed between the Civil War and World War I supported this line of thought.

Unfortunately for scholars of the American military, a similar lack of formal doctrine seems to exist for World War I. Since Rains' book was apparently lost, and the archives of the Torpedo Bureau suffered a catastrophic fire which destroyed many

records, American soldiers preparing for combat had almost no new material to study.[33] William R. King's book, *Torpedoes: Their Invention and Use*, was somewhat insightful and useful as a recent history text of landmines for military students. However, it merely collected much of the aforementioned correspondence among general officers regarding landmines and appears not to have had an influence on practice and procedure. The only formal doctrine which existed was in an engineer manual from 1912:

> It is **not permissible** to plant such mines in any ground which is **not obviously** prepared for defense. Any person who ventures on space so prepared does so at his peril, but if there is a road or path open to passage through such ground mines must not be placed therein, or in a place where the explosion would injure persons occupying the road. If any defensive works or recognized obstacles are thrown across the road, indicating that it is closed to traffic, the road may be mined to a reasonable distance in front of them [emphasis in the original].[34]

The first edition of this manual was printed in 1909, but the earliest available today is the 1912 fourth edition. This appears to be the earliest existing formal directive, published by an official organ of the U.S. military, which conforms with the general thinking about proper and effective landmine employment as far back as the Civil War. Several more manuals were used in the late 1800s at West Point and other schools, such as Oswald Hubert Ernest's *Manual of Practical Military Engineering* (1873) and William D. Beach's *Manual of Field Engineering for the use of Officers and Troops of the Line* (1894). However, these manuals merely outlined how-to procedures and considerations of effective placement. They did not address whether certain uses of landmines were murderous and barbarous as the Civil War generals would have put it. The 1912 *Engineer Field Manual* was the first to consider this. (Of note, however, is that the 1894 Beach manual appears to be the first official military document which called landmines by that name rather than "torpedoes.")[35]

Thus the first doughboys training for and deploying to World War I almost certainly had this 1912 manual as their written doctrine for appropriate uses of landmines. Later manuals, such as the 1917 *Complete Infantry Guide*, merely quoted the 1912 *Engineer Field Manual* verbatim. A Civil War mindset, therefore, guided the U.S. military's landmine employment in World War I, at least on paper.

U.S. landmine doctrine experienced very little advancement during World War I for the same reasons that Union landmine use was almost nonexistent during the Civil War: landmines strongly favor the defender, and offenders therefore have little impetus to refine either their effectiveness or doctrine concerning their employment. By the time that Americans first appeared in large numbers on European battlefields, it was 1918 and the Allies were on the offensive. They gave little thought to landmines, a defensive weapon. Conversely, the first mass-produced landmines in history appear to have been manufactured by the Germans in a desperate attempt to somehow counter what was then the new concept of the armored tank. After the Battle of Cambrai in November 1917, although they eventually retook the ground lost, the Germans were alarmed and needed something to counter the tank. They began to develop a multitude of weaponry to counteract armor, such as anti-tank (AT) direct-fire weapons and armor-piercing ordnance. Front-line German troops first improvised AT mines out of artillery shells, much as Gabriel Rains had during the Seminole War almost a hundred years earlier. They buried these shells nose-up with flat boards covering the impact fuze. When the tank functioned the fuze, the shell would detonate, hopefully killing the crew or at least resulting in a mobility kill, allowing German infantry to clamber to the top and kill the men inside.[36]

By early 1918, Germany was mass-producing AT landmines, which were in the early incarnations little more than wooden boxes filled with guncotton and sealed to keep the charge dry. These were functioned via pressure fuze. As German armor production gradually increased, the British began to manufacture their own AT landmines of much the same box design.[37] Although certainly fascinating technically, other publications contain detailed descriptions and diagrams of these mines. They were, however, responsible for some of the earliest known official U.S. military publications on disabling and disposing of landmines. This work would come to be called Bomb Disposal (BD), in World War II. Today it is called Explosive Ordnance Disposal. One such description of early disposal procedures read that since the AT mines required a great deal of pressure to function, they "have been thrown about with impunity."[38]

Unfortunately though, historians, reporters, and GIs themselves were certainly highly interested in landmines, American doctrine writers showed little interest in updating landmine doctrine during World War I and for many years thereafter. The one exception seems to be Lieutenant William A. Mitchell's 1928 edition of *Fortifications*—but rather than further restrict the restrictions on improper landmine use, Mitchell removed all ethical conditions. Other manuals of the period which quote Mitchell fail to restore the preconditions for landmine use outlined in the 1912 *Engineer Field Manual* and other earlier doctrine. This removal of restrictions on landmine use brought the U.S. military more in line with other Western countries' contemporary doctrines. It also signaled the last serious thought that American military thinkers would give to landmines until 1939.[39]

Furthermore, the lack of serious thought to landmine employment was accompanied by a disinterest in procuring or training with landmines during the interwar years. Indeed, the United States did not produce a single AT landmine until the M-1 Anti-Tank landmine began production in 1941. One year later, only two landmines had been added to the U.S. arsenal, both of which were anti-personnel (AP) mines.[40]

Part of this hesitation to develop or produce landmines certainly had to do with the disgust many Americans felt after World War I. Indeed, the emotional scars left by the brutal, vicious war led to many Western nations neglecting to develop or innovate during the interwar years. Citizens were loathe to spend a great deal of money on defense when those funds could be spent rebuilding nations devastated by the war. The Great Depression also crippled many nations financially, leading to even less money going to research, technology development, and expensive training on newfangled tactics.

From the time young Gabriel Rains first improvised his subterra torpedoes in 1835, the weapons gained a curious and disproportionate reputation. Various inventors, including Samuel Colt, experimented with various designs, but it was not until the Civil War that serious attention began to be paid to landmine development and employment. This is partly thanks to the Confederate president. Were it not for the reports from the Seige of Sevastopol sparking the imagination of then-Secretary of War Jefferson Davis, a fascination which would endure when he was President of the Confederate States of America, landmines may not have been contemplated in American circles for another hundred years. Almost immediately, Rains and others began innovating and toying with new configurations. These trials proved the utility of electrically-initiated landmines and

various safety measures to prevent accidental detonation. They also proved that landmines could be a great help to outnumbered defenders and armies in retreat.

The Civil War also illustrated how dreadful and controversial landmines quickly became, from lowly privates all the way up to the highest ranks. In what would become a recurring theme, despite the revulsion many felt about them, landmines continued to be employed all over the country during the war, even in murderous and barbarous ways. Perhaps most illuminating of all, the Civil War introduced a rule of thumb with regard to landmine development: defenders' desperation drove their innovation and employment, whereas belligerents with a strong upper hand rarely even gave them much thought. Landmine warfare allowed David to fight Goliath.

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CHAPTER 3

HOUSEMAIDS WITH HOOVERS

World War II and Korea

A common theme began to develop during World War II with regard to development of landmine employment. The American military is historically offensively-minded, preferring conflicts where it presses the attack against its opponent rather than conducting long-term defense. As a consequence, defensive warfare is considered and refined to a lesser extent than that of offensive warfare. For American officers who value aggression and rapid attack, defensive doctrine and innovation may be almost an afterthought.

Indeed, before World War II, the last time American landmine development experienced a significant infusion of energy and effort was the American Civil War. The Civil War was the only conflict with a large number of Americans engaged in large and long-term defensive operations. The fast-paced, almost completely offensive nature of American operations in both World Wars meant that there was little attention paid to developing innovative defensive weapon systems and practices. Unsurprisingly, American landmine (and seamine) practice and development, with corresponding amendments to doctrine, leapfrogged during the 1860s and the decades thereafter. Similarly, landmine development and doctrine has never grown at the same pace since that time.

While the United States was slow to update its landmine approach and arsenal, World War II did produce some significant changes. Though not nearly as radical as the changes during and after the Civil War, these amendments were still significant. They

were also, apparently, sufficient. Even when the American military found itself once again in a rare large-scale defense in Korea, the landmine doctrine which grew out of World War II was not abandoned, only reaffirmed.

Interestingly, though U.S. landmine doctrine did not change radically during the World War II-Korea era, the technology did. These innovations were necessary adaptations to new technological and employment developments by the enemy. A similar need had led directly to the development of the first AT mines during World War I, in response to the newfangled armored vehicles. New (or newly observed) enemy tactics also spurred innovation. Several landmines still in the U.S. arsenal were direct responses to novel enemy battlefield tactics.

The opening salvos of World War II caught the American military unprepared for mine warfare, which had improved worldwide since 1918. As mentioned in the previous chapter, by 1941 the United States had only added a single AT landmine, the M-1, to its arsenal. A year later it had only two additions, small AP mines. The quantity of mines in the arsenal was so low that after Pearl Harbor, when American soldiers were attempting to secure Hawaii against a possible Japanese ground invasion, there were no mines available to use for the defense.[1]

As with many aspects of warfare, Americans' approach to landmines, both in technological and doctrinal terms, was heavily informed and influenced by those who had gone before. After all, by the time the United States was involved in actual combat, many European nations had experienced five to ten years of ongoing conflict. American leaders wisely chose to stand on the shoulders of giants, so to speak, and adopt practices from the British and other allies. The first American BD soldiers were educated at British schools.

They also gleaned useful information from reports of enemy activity. Many American mines introduced to the arsenal during World War II and the next decade were close copies of German mines. Americans also developed or adopted several pieces of equipment, such as detectors and flails, which had been developed by allies or enemies.

Several major engagements influenced Allied, and therefore American, landmine philosophy in World War II. The defense of Britain was the first large-scale mine laying operation by the United Kingdom during the war. Unfortunately, due to the widespread panic after Dunkirk in 1940, most of the mining of the beaches on the south and east coasts on England were initially poorly documented. Compounded with the low levels of training many British troops had received, this led to several accidents in which British units wandered into inadequately-marked fields laid by sister units. Tragically, several were wounded or killed over the next few years in these incidents.[2]

One silver lining of this unfortunate shortsightedness was that it drove British innovation in detection and clearance. In both equipment and technique, the British would lead the BD field for the next few decades. The Luftwaffe dropped bombs all over England. There were millions of mines, unexploded odnance and booby traps cleared by British soldiers in various theaters during the war. However, the impetus for the initial innovations in British mine and countermine development was its own botched mine-clearing operations after Dunkirk. Americans and other Allied nations would benefit from British innovation in these fields for decades to come.[3]

One of these innovations was the first man-portable metal detector accepted for use by a national military. The British War Office accepted a design from Lieutenant Jozef Kozacki, a Polish officer who had escaped capture and made his way to Britain in

1940. His device was used by British and Allied soldiers throughout the war. The mine detector was adopted by all militaries during the war and has been included in the American bomb disposal tool kit ever since. Versions and upgrades of the original Kozacki design were used as recently as 1995.[4]

There were many other innovations in technique and design. The ingenuity of soldiers is rarely on better display than when they are adapting to a new situation. Detection and clearance of minefields yielded a wide range of creative solutions, some of which worked much better than others. Early in World War II, methods for detection were restricted to probing with a bayonet or other implement, or relying on the unaided eye to detect disturbed soil. Some of the proposed improvements did not really improve anything. A system created by South African engineers, working in the East African theater in 1941, consisted of a long concrete-filled barrel which would be dragged by a mule through suspected minefields, in order to function or unearth any mines.[5]

Another questionable creation, also the brainchild of South Africans, was a towed system of hooks dragged behind a motorcycle. The hope was that when trailed at slow speeds, the hooks would merely skip along hard pack soil but would bite into any softer, recently disturbed earth, exposing newly-laid mines. The motorcycles would be driven two abreast in front of advancing motorized or mechanized columns. Though reports indicate that this method seems to have enjoyed some success, no data exists for the mule-dragged barrel system.[6]

The North African Campaign also presented belligerents with great opportunity to innovate and test new mine laying and clearing approaches. The flat pan desert was a tanker's dream, and it therefore necessitated a great deal of minelaying capability on the

defender. As Brigadier B. K. Young put it, the side with armored superiority "imposed on the other side the need for more and more minelaying as the only countermeasure."[7] The campaign was characterized by many reversals, with attacker and defender often switching in a short time. Due to this and the sometimes long and unresponsive logistical lines, the practice of using captured enemy mines was adopted by all belligerents. Though obviously not optimal, this meant that a necessary component of mine training for soldiers was a working knowledge of how to emplace and employ mines from the enemy's arsenal as well as their own. Though the British managed to build mine factories in Egypt once it had fallen to Allied advances, the use of enemy mines was still commonplace. The British mine factories in Egypt also had no qualms about copying German designs, particularly the bounding S Mine, which when functioned was propelled upward to explode at torso level. The British versions were made without built-in anti-disturbance booby traps. The British also used few AP mines, in Africa and in all other theaters. This lack of anti-handling and AP mines, coupled with the peculiar British unconcern with covering their mine marshes with direct fire, unfortunately meant that Germans in North Africa were often able to dismount and clear lanes in front of their tanks at a relaxed, leisurely pace, without fear of direct fire, before advancing. The other type of British minefield, the "box," was protected by direct fire and was often employed around prepared defensive positions.[8]

In spite of the baffling failure of the British to cover all their minefields with direct fire, their laying techniques were effective enough to impress Rommel himself. He noted the quantity of mines laid and how they worked to force an attacker to fight in a place and manner of the defender's choosing. As he advanced toward the retreating

Allies, they would recover their own mines when able to do so, in preparation for what was then seen as the last-ditch effort to protect Egypt and the Suez. (The Allies' failure to recover as many mines as possible during this time spurred an increased production of the then-still-experimental Polish mine detectors.) Once his El Alamein drive lost momentum and he found himself on the defensive, Rommel used mines himself. Indeed, he relied on them so heavily that when issuing the order to establish the defensive line he created a new term for it, a Devil's Garden. In deference to the extreme amount of mines in the German line—over 500,000 in two major fields, with a depth of an astonishing five miles—the Allied attack was named Operation Lightfoot.[9]

More experiments with detection and clearing took place during these times. A heavily-sandbagged truck with an attached frontal spiked roller, called a pilot truck, was intended to detonate the first mine while leaving the driver unscathed. The trucks were also called funnies or Aunt Jemimas because of their claptrap, thrown-together appearance. A number of amusing, in retrospect, observational notes can be found with regard to these vehicles, such as one from the *Tactical Employment Handbook* which stated that the drivers of such vehicles were "subject to considerable strain of a peculiar nature."[10] Another innovation, one much better received by the poor soldiers assigned to drive them, was the flail or Scorpion tanks. These were armored vehicles with spinning lengths of chain attached to a horizontal beam, mounted to the front of a tank.[11]

The Scorpion tanks were first used during Lightfoot. They were still unrefined and therefore not as effective as they would become later in the war in places like Italy. The German defenders were even more terrified of the flail tanks than of the artillery barrages. The massive dust plumes kicked up by flails were bad enough. Even worse, out

of the dust came an inhuman sound which one German described as “dreadful noises of clanking, groaning and rattling chains.”[12] As with other aspects of mine warfare, the effect was more powerful psychologically than tactically.[13]

Other techniques were less alarming to the enemy but more successful in breaching and clearing fields. In addition to the pilot trucks and flail tanks, British sappers had tentatively developed a breaching method, to be used under fire. A pilot truck would move forward until detonating a mine, at which point sappers would dismount and conduct probing and disarming by hand. This resulted in heavy casualties, but did effectively lead to breaches in some areas of the line. The most effective technique was slow, methodical prodding. Though by far the most effective of the methods, prodding was so slow that to conduct it under fire was something akin to suicide. A combination of these four techniques—pilot trucks, flails, breaching drills, and prodding—finally resulted in the Allies breaking through. However, this was only after Rommel launched an uncharacteristically ill-advised counterattack, badly weakening his remaining forces. After the Allied breakthrough, Rommel was forced to withdraw to Tripoli.[14]

During the withdrawal and final stand at Tripoli, the Germans engaged in a technique first used by Gabriel Rains’ Confederates during the American Civil War: nuisance mining and booby traps. Some mines were buried much deeper than normal, allowing multiple trucks to pass over until the rut became deep enough that a truck was finally able to function the mine. Souvenirs such as binoculars with Nazi emblems and other trophies were booby trapped. The Germans scattered scrap metal around their minefields to fool mine detectors. And in a particularly spiteful tactic, after they mined the runways in and around Tripoli, the Germans would defecate into the hole before

filling it. If the mine detonated, nearby personnel would be exposed to flying human waste. If the mine were discovered and cleared, the unfortunate bomb technician would be forced to shove his hands down into the putrid mess to conduct his work.[15]

Though not an American action, all this British innovation during the North Africa Campaign would influence the American landmine philosophy greatly. The reputation of the disposaleer was set by Royal Engineers during this campaign, and the reputation has endured. The image is one of a man who, despite the chaos and noise of the battle around him, focuses intently and deliberately on the ground and the mines he clears. He ignores the screaming death all around him casually while he engages in his work. Almost as if he were a maid cleaning a house rather than a man in the midst of a murderous engagement. This led one War Office report to refer to disposalmen as "housemaids armed with Hoovers."[16]

Several more technological advances grew from the North Africa Campaign. Though they were later abandoned as ineffective by Axis powers, the campaign saw the first use of air-dropped mines. The Italians pioneered and experimented with a system of scatterable mines called thermos bombs after their cylindrical shape. The mines would drop to the desert surface and arm upon impact, with an anti-disturbance fuze which would function if the mine were moved. The Italians were never convinced of its effectiveness, so the thermos bomb was rarely used again. This novelty paved the way, however, for future air-delivered mines, which were used in great numbers by the United States during the Vietnam War.[17]

The Germans were the world leaders in landmines when the war began, and throughout the war they would lead the other belligerents in both quantity and types of

mines produced. Their ally, Italy, was also an enthusiastic producer of mines, and this continued after the war for many decades. The Germans were constantly experimenting with improvements to design, yield, and detectability. They pioneered many of the features and techniques which would later become common practice for all mines. For instance, the Tellermine series, round, flat AT mines, were the first to feature anti-disturbance mechanisms, which would function the mine if it were lifted. This prevented easy clearance and led BD soldiers to change their practices to check for these mechanisms.[18]

Whereas the Tellermine series was AT, the Schutzenmine (or S Mine) series was a particularly feared AP mine. Typically categorized by disposalmen as belonging to the bounding fragmentation group, the S Mine contained a small propelling charge at its base which would shoot the mine's main body three to five feet into the air. The main charge would detonate there, at waist to neck level, spraying irregular steel fragments over 150 yards in all directions. Though modeled after the Aacen mines used by the Germans during World War I, it is likely that the S Mines used during World War II are the first bounding fragmentation mines ever encountered by Americans.[19]

In addition to having a larger arsenal and number of mines, the Germans led the development, often experimenting with new ways to avoid detection. The first of these were wood, such as the Schu-mine. The Italians also experimented with ways to avoid detection, and were the first to experiment with bakelite, in their AP Pignone mine. Some of these non-metallic mines were still detectable by Allied forces, however, due to tiny bits of metal within, such as springs or screws. Some newer detectors, such as the American M-1 and later version of the Polish design used by the British, were extremely

sensitive. To truly avoid detection, mines would have to be constructed using no metal whatsoever.[20]

The Germans' Topfmine and Glasmine were other attempts to counter the rapidly-improving Allied forces' mine detection equipment. Using no metal whatsoever, the Topfmine was an AT mine with a plastic body and components made of wood or glass. The AP Glasmine was constructed entirely of glass. Both of these mines using chemical ampoules rather than metal springs or screws in their fuzes. Interestingly, the Glasmine's fuze, although of course made from glass, was an identical copy of the one developed by Alfred Nobel (and later used by Gabriel Rains) in the middle of the previous century.[21]

The Germans and their Italian allies were also the first to introduce innovations such as the bar mine and the tilt rod. Previous AT mines depended on a vehicle's wheels or track striking the mine. The bar mine was shaped like a long, flat board, and laid laterally across a road or likely avenue of approach, increased the exposure area and therefore the likelihood of being functioned by a wheel or track. The Italians initially produced two versions of the bar mine, the Germans one.[22] The tilt rod was an addition to the fuze of an AT mine shaped like a modern car antenna. Projecting two or three feet up from the mine, it would catch on the underside of a vehicle, tilting as the vehicle pushed on it and functioning the mine.[23] Bar mines and tilt rods were so effective that they are still produced and employed by various militaries today.

When Americans first arrived in Europe in large numbers, they were woefully unprepared for mine warfare. One officer called mine warfare an American soldiers' "Achilles' heel."[24] The U.S. Army lacked proper training and equipment, and had not

updated its landmine doctrine since the interwar years. What detection equipment it had was found to be unreliable in wet weather and often gave faulty readings in areas with large deposits of iron ore. Furthermore, unlike the flat, barren Africa desert, European terrain was often hilly and broken. This gave Axis soldiers the ability to hide mines among brush or tall grass, or use them in conjunction with existing terrain obstacles such as ravines or rivers. This new set of circumstances led once again to Americans rapidly innovating in their approach to landmine warfare.

One positive note is that once mine training began for U.S. forces, it tended to be very realistic. U.S. soldiers began attending British mine training (in addition to other British schools), taking full advantage of the harsh lessons learned by their ally. The British mine school in Morocco was so realistic, in fact, that twenty-eight Americans were injured, and one killed, during the training. This sounds harsh to modern ears, but it reinforces the fervent desire of military leaders to recreate realism, and may find some sympathy among modern leaders who exhort units to train as they fight.[25]

The innovation began almost immediately, with Americans in Italy utilizing bulldozers to scour the top few inches of soil to clear paths for following troops. The drivers wore flak suits similar to today's explosive ordnance disposal bomb suits. Though many were injured when they struck mines, some even being flung from their seats, no record exists of any that were killed. In other cases Americans would herd flocks of sheep or goats into suspected minefields in order to function any mines there.[26]

Other clearing techniques developed during the Italy campaign focused on clearing narrow paths using explosives. One method was a rifle grenade with a length of detonating cord attached. When detonated, the cord left a clear path about a foot-and-a-

half wide. This would detonate most Schu mines and cut tripwires. Another method was the Snake, which was a larger version of the bangalore torpedo. Developed by a Canadian Royal Engineer, it was a long tube of explosives, pushed into a minefield by a tank and then detonated to clear a path through the field. Flails also continued to be used, but Americans soon discarded these, or at least avoided using them if possible, since they frequently had maintenance issues.[27]

This would become a recurring theme, and a bit of a sore area with their British BD comrades: whereas the British preferred to use gadgets and clearing vehicles such as pilot trucks and flails, Americans preferred to use dismounted soldiers with detectors and probes. The British thought that the American approach risked too many lives; the Americans thought the British approach relied too heavily on gadgets. Liddell Hart would later say that the "American troops paid dearly for the higher commander's hesitation" to use clearance vehicles such as Scorpion flails and others such as the "funny" vehicles.[28] American commanders, on the other hand, pointed out the high breakdown rate of these vehicles, with one division commander calling his "Aunt Jemima" vehicles "the most effective road block in Europe."[29] Although no doctrinal emphasis exists, the American mine clearing modus operandi for World War II seems to have been an unwritten preference for hands-on work, with detector and bayonet and probe.

As far as employment, the U.S. used landmines infrequently, since Americans were so rarely on the defense for significant lengths of time. When they did use them, Americans suffered from a lack of experience and the rigid discipline which usually characterized the German use of landmines. The British, Germans, and other belligerents, who had entered the war much sooner, had all developed their own methods for laying

minefields. These usually consisted of teams of a few men, with one sub-group assigned to emplace, another to arm and conceal, and the officer or non-commissioned officer in charge carefully recording locations of each mine. Hard experience had taught all sides that the price for keeping incomplete record of exact locations was often paid by one's own side. Examples abound of units on all sides blundering into their own fields early in the war. After a few similar incidents, Americans refined their technique and adopted a better method for laying and documenting minefields.[30]

In the American system, one soldier would mark, on the ground, the location of each mine to be emplaced. Another would place the mines. Bringing up the rear was a team of two men, to arm and camouflage the mines. The work was slow and laborious, and combined with the exacting record-keeping process, could be very time-consuming. Both to save time and to reduce risk to their own personnel, Americans sometimes decided not to mix AP and AT mines. Rather, the two types would be separated, with AP mines in front of a barbed-wire obstacle and AT mines behind. This method was used by American soldiers at Anzio in April 1944 when they were forced to defend their tenuous beachhead. Even with the time-saving choice not to mix the minefields by type, it still took the 109th Engineer Combat Battalion over 240 man-hours to lay just 2,444 AT and 199 AP mines, and an additional 96 man-hours to mark and record the field.[31]

Further harsh experience taught American soldiers not to lay mines too close together. During the same time period at Anzio, the 39th Engineer Combat Regiment had just finished laboriously laying a dense minefield when a single mortar detonated the entire field. Afterward, the United States adopted a maximum density ratio of 1.5 AT mines per yard of front, and 1 AP mine per three yards of front.[32]

America's entry into World War II threw a great many deficiencies into sharp relief, but one of the most startling was how behind the times America was in mine warfare. Germany had spent the interwar years developing and testing new technology and employment methods, and the rest of Europe had at least several years' head start on the United States by the early 1940s. The influence of the defensive versus the offensive on the pace and fervor of landmine development cannot be understated as well: by the end of the war, the United States still only had a handful of landmines in its arsenal. The Germans, on the other hand, introduced a new mine, on average, every three months throughout the entire war. Their military thinkers also anticipated the coming cat-and-mouse game between minelayer and disposalmen by developing the anti-handling device. With characteristically German efficiency, they even mandated that screw threads in all German mines were to be of identical size so that the lift devices and even fuzes could be interchanged quickly.[33]

This contrast characterized the nature of American mine warfare development. Compared with other countries, it was often haphazard and appeared free of any underlying greater direction. The British, Germans, and others had a regimented development program. The American mine program grew only in fits and starts, and the doctrine was updated infrequently. Perhaps this was due to the American character and preference for offensive warfare.

The Germans may have lost the war. Their dedication to mine warfare, however, forced the United States to innovate and counter-develop like never before. American landmine practices and experience grew by leaps and bounds out of bloody necessity. In the campaign to liberate northwest Europe, 20.5 percent of Allied tanks were lost to

landmines—compared to only 14.5 percent destroyed by other tanks. Such a startling set of numbers surely compelled American planners and developers to greatly emphasize mine warfare education. This is likely what led to the unforgiving nature of the anti-mine training, which as mentioned above, frequently injured or even killed its own students in the quest for the utmost realism. This symbiotic relationship between innovations, with each successive technique or technology feeding its successor, is exemplified by landmine warfare in the European theater during World War II.[34]

The Pacific Campaign, on the other hand, was in some ways a regression to the Civil War and World War I eras. Landmine use by the Japanese was much more like the original mines cobbled together ad-hoc out of spare ordnance and scrap materials. U.S. servicemembers in the Pacific were much less likely to encounter the regimented, mathematically laid minefields of the Axis forces in Africa or Europe. The Pacific landmine war was much more haphazard, and therefore in some ways much more brutal.

There were also some fortunate factors that contributed to the Pacific theater being less deadly in terms of landmine casualties than the other theaters. One of these factors was the extreme geography. Though Europe was mountainous in certain areas, in other areas there were enormous plains which were broken only by gently rolling hills. These areas, which enabled lightning-fast armored warfare, were also prime terrain for conducting landmine warfare. Modern landmine development and employment were spurred by necessity in a desperate attempt to counter what was then the newfangled armored vehicle. In terrain which prohibited or at least greatly hindered effective armored movement, therefore, there was much less need for anti-tank landmines. Another factor limiting landmine warfare in the Pacific was the logistical one. Fairly quickly in the

campaign, many of the isolated island Japanese garrisons were effectively cut off from any resupply. Even those islands closer to the home archipelago might receive resupply only intermittently due to increasing harassment from Allied aviation and naval power.[35]

Neither the logistical nor the terrain factors, however, reduced the danger of landmines in the Pacific theater. Despite lagging far behind the other Axis powers in technology and doctrine, Japan still far surpassed the United States. The Japanese continued to develop mines throughout the war, although they would not issue formal landmine doctrine until 1944. Japan had developed an AT, the Type 93, long before the United States had a single mine in its arsenal. However, the Type 93 would prove ineffective against heavier armor. Later in the war, the Japanese had to resort to planting additional explosives underneath the Type 93 to make it effective against the newer tanks.[36]

The use of tanks, and therefore the need for AT landmines, being limited by terrain, the Japanese focused on developing and employing AP mines. In addition, they produced some interesting innovation in beach mines to counter the ubiquitous amphibious assaults which the Americans were forced to undertake at each island. One such was the Type 96 beach mine, which resembled a traditional spherical sea mine cut in half. A dome with long prongs (or horns in seamine terminology), it was laid either directly on the sand or a few feet below the water. Each horn contained a glass ampoule which contained an electrolytic fluid. When a tank or landing craft approached and its hull struck one of the horns, the crushed ampoule would release the fluid to react chemically with an electrical fuze, detonating against the underside of the vehicle. Though the Americans quickly began employing bulldozers with V shaped blades, to

push these beach mines aside rather than function the horns, the toll taken by these was still significant.[37]

Another innovation of the Japanese was a version of the bar mine which the Americans in the Pacific dubbed the yardstick mine. This long, flat steel bar about three feet long was fitted with four pressure devices along its length which detonated an approximately six pound charge. Much like the bar mine, its length made vehicles more likely to strike and function it. Intriguingly, the Japanese also came up with the idea to scatter yardstick mines on abandoned Japanese airfields. An American plane attempting to land without adequate prior ground clearance could possibly roll over and detonate a yardstick mine, damaging the plane and maybe killing the occupants.[38]

Like their Axis fellows, Japan recognized the Allies' advanced detection capability and began to experiment with non-metallic materials for mine construction. These were the Type 3 mines. Type 3, Model A, was made of earthenware with bakelite internal components. The only metal pieces were some springs, pins, and the striker. The Type 3, Model B, was made of wood, with the internal components the same as the Model A. These mines were further subdivided into two sizes (4.5 or 6.5 pounds of explosives), but the unique feature of the Type 3 was its fuze, which could be functioned by pressure or being pulled. This allowed the mine to be used as a pressure mine or with a tripwire, without having to change the fuze.[39]

Either size on the Type 3 mine was enough to blow the track off an armored vehicle. Americans were further hindered in mine detection by the fact that the soil on some of the Pacific islands was very metallic, leading to frequent false positive readings.

This led to a regression to hand probing for detection, which meant much slower advances. The Type 3 mine family was first encountered by Americans on Leyte Island.[40]

Japanese soldiers may have lacked formal landmine doctrine for much of the war, but this and their sometime lack of robust logistical support did not prevent them from innovating at the tactical level. They innovated out of necessity much as the soldiers in the trenches in World War I had been forced to do. Also first encountered by Americans on Leyte Island was the coconut mine, which was a hollowed coconut with a Model 91 hand grenade inside, the remaining space being packed with gunpowder. These were described in an *Intelligence Bulletin* as "simple but not particularly effective."[41] However effective they were, they must certainly have succeeded in a secondary purpose of mine warfare, which is to instill dread and fear in the enemy. Alternate improvised mines used wooden boxes instead of coconuts, or artillery shells or other ordnance instead of a hand grenade.[42]

Another improvised mine was the Mark I mine. Here, the Japanese effectively copied the infamous German Aacen mine of World War I. A 155 milimeter artillery shell, fitted with a pull fuze, was stripped of its fins and placed atop a bag of black powder inside a container. When the powder was set off, it acted as a propelling charge and projected the shell upward, where its pull fuze was functioned by a chain attached to the container. The shell detonated at approximately five feet and American soldiers seeing it in action estimated its effective range as about 70 yards.[43]

In a further regression, Japanese soldiers in the Pacific also made use of *panji* pits which resembled the old lily pits described in Caesar's siege at Alesia. These camouflaged pits were filled with pointed stakes and were not only used as components

of defensive perimeters but also to delay advances or cover retreats. American soldiers would see *panji* pits again in future Asian wars. Americans in the Pacific occasionally used them as well, as part of their own defenses or as booby traps.[44]

Throughout the Pacific Campaign, and although their arsenal was more developed than that of the United States, Japan's use of landmines was not executed under a unified doctrine or employment guideline. They were often employed haphazardly and with poor concealment, and were often not covered by fire. For most of the war, Americans in the Pacific found minefields much easier to clear than their counterparts in other theaters. The Japanese formally established a modern landmine doctrine in 1944.[45]

The Japanese defense at Iwo Jima appears to have conformed to much of the updated doctrine. Minefields were often covered by protective fire, and appeared to be laid out in organized fields. They were marked on the Japanese side, to prevent them from wandering into their own fields. The defenders even used organized AP minefields, apparently for the first time in the war.[46] The vast improvement in Japanese landmine warfare practice during Iwo Jima suggests that had they been given a few more years, it could have presented a real problem for the Americans; however, it was simply too late in the war. Only a few months after Iwo Jima fell, Japan surrendered. Had Operation Downfall been executed—had Americans invaded mainland Japan—this updated Japanese landmine warfare doctrine would have had the potential to cost extraordinary numbers of American lives.

Although less armor was used in the Pacific as compared to the European and African theaters, 31 to 39 percent of American tanks lost during the Pacific Campaign were due to mines.[47] This compares to only 20.5 percent of Allied tanks lost to mines in

Europe. Again, this also compares to only 1 percent of personnel lost to mines during the Pacific campaign.[48] So despite the much smaller area the Japanese had to employ them, AT mines were much more effective in the Pacific theater, at least statistically. This is due not to Japanese expertise as much as to the extremely limited area in which vehicles could maneuver on the islands. Much more constraining geography led to vehicles being much easier to target through mine warfare.

Whereas World War I introduced the landmine as an unformed, undeveloped form of warfare, World War II demonstrated its full potential. Mines were ubiquitous, striking fear and dread into foot soldier and tanker alike. They allowed the defender to attrite the attacker with great economy and to retain the initiative. The belligerents engaged in a race of innovation, development, employment method, and refinement of doctrine. Of course, many other weapons, systems, and forms of warfare were undergoing the same crucible. Landmine warfare, however, was one of the few for which World War II was its true inaugural laboratory, its introduction to the wider industrial and civilized world.

Landmine warfare also proved itself in another way during World War II. Landmines were always used to shape the battlefield physically, to channel one's enemy on the kinetic space of battle. World War II showed that they could also shape the battlefield tactically, to channel enemy psychologically. Rather than just limit the enemy to several lanes of approach advantageous to a defender, landmine warfare could limit him as well in his selection of unit configurations and his consideration of casualties. North Africa demonstrated this. Though not an American action, the British assault on El Alamein (codenamed, remember, Lightfoot because of the huge influence landmines had

on the planning) is an excellent illustration, as Rommel's Devil's Gardens forced the British to attack with their tanks in file rather than in extended line. This was so foolhardy under other circumstances as to be considered suicidal, but with such dense minefields covered by withering protecting fire, it left the British little choice.

Another example of landmines shaping psychologically as well as physically was the birth of the mystique of the mine clearance soldier. They have been called Sappers, BD men, or more currently, Explosive Ordnance Disposal technicians. Their reputation for slow, deliberate concentration on the ground and the explosive, seemingly unconcerned while the battle screams around them, was born in the clearance operations in North Africa. BD programs in the United States and many other countries began with soldiers learning at the feet of their British instructors who had survived the Devil's Gardens in Africa. This expertise led to generations of bomb technicians operating at a high level of proficiency and enjoying a reputation of calm, quiet professionalism.

Landmine technology and practice improved tremendously during the war. Bounding fragmentation landmines became widespread. The advent of reliable detection equipment led to the development of non-metallic landmines. Air-dropped landmines were used for the first time, although in limited number. Beach mines were developed to delay and attrite amphibious landing forces. Greater use of wheeled and tracked vehicles, with heavier armor, led to mines with greater charges and more versatile fuzing options. Many nations improved their doctrine to formalize the method for laying, marking, and recording minefields.

Clearance methods improved as well. Vehicles were developed such as the pilot trucks, Aunt Jemimas and others, although their utility varied depending on terrain and

the observer. Detectors became more powerful and more accurate. Procedures were codified and formalized. New techniques were tried out of desperation and necessity on the battlefield. The successful techniques were taught to new soldiers before they went into battle, in realistic-as-possible training which, at times, was so realistic that it maimed or even killed students.

Perhaps most importantly, the more introspective thinkers realized the devastating effects landmine warfare had on the character and gravity of a conflict, even as it was underway. The knowledge that mines were out there, waiting to reach out and snatch the life right out of one's body, filled soldiers on the offense with a constant, hanging dread. For a defender, the knowledge that one's own landmines were laid, protecting him from the enemy, allowed him to breathe a little easier, and perhaps even inspire him to defiant bravery. John Slaughter, an American soldier at Vierville, remembered a German prisoner being interrogated by an American officer. On his knees, the prisoner was asked to give the location of the German minefields in the area, and when he refused, the officer became enraged and fired his rifle in between the German's legs, very near his genitals. Again, shouting the officer demanded the location of the mines. With a smirk on his face the German pointed to his crotch and said, "*Nichts hier;*" then he pointed to his head and said, "*Hier.*"[49]

The Korean conflict was one in which both sides were alternately on the offense or the defense, giving both ample opportunity to use landmines. Unfortunately, Chinese and North Korean records are still largely unavailable to the West. However, some enemy techniques and practices can be deduced through after action reports and other accounts.

The North Koreans and Chinese did not use landmines to the extent of the Axis during World War II. For the mines they used, however, they had seemingly been impressed with accounts of Allied detection and clearing capability. Their minefields reflected this. The North Koreans primarily used non-metallic mines of Soviet design, such as the TMD and the PMD 6, which were old-style box mines with wooden cases. This made powered detection equipment almost useless, and United Nations forces were reduced once again to manual methods—a probe and the reliable "Mark 1 Mod 1 eyeball."[50] The TMDs and PMD 6s were often planted with grenades underneath as antihandling devices.[51]

Unlike 1941 when it was caught flat-footed, the United States had a full range and quantity of landmines in its arsenal at the beginning of the Korean War. These included AT and AP, to include bounding fragmentation mines. Also unlike World War II, this conflict did not catch the United States with 20-year-old landmine warfare guidelines. Landmine doctrine had been updated in the 1949 edition of Field Manual 15, *Field Fortifications*. This update included provisions on organized minefield laying, lanes within the field for friendly passage, careful marking and recording procedure, and even blending minefields with existing natural terrain. It allowed that these rules may be bent or discarded in times of emergency, such as during retreats or drastic situations. In those times, it was more important to delay an enemy, cause him as many casualties as possible in a short time, and hurt his morale. However, such disregard for the rules was only to be at the order of a corps or higher echelon commander. Only at those levels and above could a commander decide the situation was drastic enough to warrant haphazard and wanton minelaying.[52] This edition even included detailed instructions for assembling and

employing explosive booby traps. World War II's brutality seemed to have disillusioned Army doctrine writers of the belief that mine warfare could be gentlemanly and civilized in all situations.[53]

Despite the updated doctrine, many American landmines were leftover from World War II stockpiles. Their effectiveness against the communists human wave tactics, which had not been previously encountered by Americans, was debatable. This wave was exactly as its name suggests: overwhelming numbers of North Korean or Chinese soldiers would simply charge the minefield or defensive position headlong. Even the strongest field or defender would eventually break under the strain of a continuous wave. Sometimes the United Nations' minefields were enough to break the human wave. One American officer at Naktong claimed that AP minefields around the defensive positions killed over 100 enemy in a single two-hour night attack. Despite the enthusiastic use and ready supply of landmines, the human wave tactic often overwhelmed United Nations' positions in Korea. The success of the human wave at Chosin in 1950 so troubled Norman MacLeod, a former Army military scientist, that he attempted to solve the problem with a new style of landmine. This convex mine was situated above the ground and command-detonated so that it propelled hundreds of small steel fragments at its target. Ideally, an area many yards wide would be scythed with these fragments, cutting down large swaths of the enemy at once. MacLeod, whose name was obviously of Scottish derivation, called his mine the Claymore. After a few revisions it was adopted in 1956. Versions of it would be used for decades.[54]

Korea also saw the first widespread American use of air-dropped (or scatterable) landmines. The M-83 butterfly bomb was a disturbance-fuzed AP mine dropped from the

air. Once free of the aircraft, the flow of air would cause curved wings to open and rotate in the wind. After a certain number of rotations the fuze would arm. The anti-disturbance mechanism would function the mine if it were disturbed by a passing soldier (or animal, or civilian). They were often painted green or another color which matched the vegetation or terrain. The M-83s were demoralizing to ground troops, particularly when used at night or when dropped in conjunction with conventional air-burst bombs. Later in the war, the American Air Force began dropping M-83s along with conventional bombs. Enemy ground troops fleeing to shelter from the conventional bombs had to run through areas saturated with disturbance-fuzed M-83s. The butterfly bombs were also somewhat successful in disrupting North Korean supply routes and movements. Interestingly, the United Nations Forces Korea commander, Douglas MacArthur, approved the use of these scatterable mines. This contradicated what First Lieutenant Douglas MacArthur had written in his 1909 *Military Demolitions*, in which he approvingly quoted the *Engineer Field Manual* of the same year, "It is not permissible to plant such mines in any ground which is not obviously prepared for defense."[55] Once again in the evolution of landmine warfare, circumstance trumped previous considerations on gentlemanly and proper conduct.[56]

U.S. doctrine and employment of landmines continued to develop fitfully during this period. World War II threw sharp light on America's reluctance to seriously consider updating its approach to landmine warfare during the interwar years. The country's hesitation to address a topic that was admittedly unpleasant led to it being woefully unprepared for mine warfare in Europe and the Pacific. The overwhelming data which confirmed that the majority of vehicle kills were due to landmines cannot be ignored.

When the biggest threat to tanks and other vehicles turned out to be landmines, by a large margin moreso than even other vehicles, the conclusions were unavoidable. America could not fail to address landmine warfare any longer. American officers certainly recognized the implications early in the war and as a result began sending American soldiers to the British mine schools as mentioned previously. Luckily, the United States had an ally in the United Kingdom that was already very experienced in landmine warfare.

During the Korea conflict the thinking shifted again, as human wave tactics and necessity borne of desperation led top leaders to change their approach. Air-dropped mines saw their first widespread use, and even gained approval from MacArthur, who had previously written doctrine against them. The seemingly unstoppable human wave tactic led directly to the creation of the first directional fragmentation mine, the Claymore. In both cases, the shifts and updates may have seemed haphazard. They were driven, however, by desperation. This confirms the suggestion that the final chapter on landmine warfare will never be written. No matter the doctrine or political strategic guidance, landmines are too effective a weapon to ever completely forego. Should the situation grow sufficiently dire, and if America finds itself a David fighting against a Goliath, it will almost certainly employ landmines again.

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CHAPTER 4

SOWING SALT

Vietnam

Like previous American conflicts, the Vietnam War was a catalyst for development of new landmine technology, employment, and doctrine. Unlike previous wars, however, the experience of Americans in Vietnam with regard to landmines was uncommon if not unique. Landmines had traditionally been employed, and encountered, as part of a defense, overwatched or covered by fire and often marked. In Vietnam, these characteristics were not present. There was no front in a country-wide guerilla war, so few protective minefields were used. North Vietnamese and Viet Cong instead used offensive mine warfare, not only as a means of striking fear into American soldiers but also because of their logistical weaknesses. Unable to procure large numbers of, or conduct mass training on, artillery, the North Vietnamese Army and Viet Cong (VC) "substituted mines for artillery."[1]

Mines, too, were difficult to come by for the Vietcong. Their landmine arsenal was all imported from the Soviet Union and China. North Vietnam seems not to have attempted to develop any manufactured mines itself, relying on these imports from friendly Communist countries. AT mines included the Soviet TMD and TM 46, and the Chinese Number 4 mine made of cast iron. AP mines included the Soviet PMD 6 and the newer (first appearing in the early 1960s) PMN. Both of these were difficult to detect, being made of wood and bakelite respectively, but the PMN was much simpler and quicker to arm and emplace.[2]

In addition to mines imported by Communist ally nations, the VC supplied themselves with mines stolen directly from American minefields. This practice became so frequent that one U.S. officer stated that American minefields had become a VC "ordnance depot."[3] General Westmoreland himself was aware of the problem, estimating in one case that of a field laid by Australian troops consisting of 20,000 AP mines in Phouy Tuy province, fully half had been stolen by the VC to reuse against U.S. and Allied troops.[4] The true number of Americans and friendly casualties due to stolen and reused American mines during the Vietnam War cannot be known. However, one estimate put it as high as 16 percent of Americans—and 50 percent of Australians![5]

British landmine expert Mike Croll estimates that as many as one-third of VC landmines used during the war were improvised. Hearkening back to the early days of World War I—and to Gabriel Rains' jury-rigged subterras in the Seminole War—the guerillas manufactured their own mines by hand in the field. These ranged from poorly-constructed devices using bamboo tubes as containers to unexploded American bombs wired to blow using command detonation. Sometimes the VC could not even scrape together the materiel to make these crude improvised explosive devices. Evidence of this was the VC's reintroduction of ancient battlefield implements such as the spiked lily pits used by Caesar in Silesia; and Francis Markan's old friend, the caltrop. Soldiers in Vietnam may have called it a "crow's foot," but it was identical to the caltrop which plagued countless soldiers for thousands of years.[6]

In addition to creative manufacture and procurement techniques, the VC used unconventional employment methods. The nature of a war absent of a front meant that there were no decisive areas to defend—so they used landmines offensively. Americans

had seen some limited offensive mine warfare in the Pacific during World War II, but in Vietnam it was exclusively offensive. Mines were substituted for artillery, and also allowed the poorly-equipped guerillas to engage on their own terms. The VC targeted high-traffic areas such as roads and paths. This took a particularly heavy toll on vehicles. From November 1968 to May 1969 alone, mines accounted for 73 percent of tanks and 78 percent of armored personnel carrier losses.[7] Such high numbers are perhaps due also to insurgents having less anti-armor capability than conventional ground forces, but even considering that fact, the high percentage of these losses is startling.

They were clearly startling to the American forces as well, as they quickly began implementing the practice of clearing "almost the entire Vietnam road net every day," an arduous undertaking which itself led to a significant number of casualties.[8] The effectiveness of route clearance throughout the war was debatable, as the number of vehicles killed by mines, after the war's end, was over two-thirds. Decades later in Iraq and Afghanistan, the tactic would be reintroduced and codified through various publications and "lessons learned" manuals.[9]

Methods for detecting mines echoed that of World War II. Ploughs and rollers were suggested, but both had limited use. Rollers were available but for some reason were never widely issued during the war.[10] Adding to soldiers' angst was that local citizens never seemed to trip the mines.

One newer innovation was the use of explosive-sniffing dogs. The first field trials with the dogs concluded that they missed the explosives approximately 16 percent of the time. Despite this and the fact that several dogs were wounded while testing, the dogs were approved for use after the tests were completed in 1970.[11] A program which paid

cash rewards to civilians who informed US forces of mine locations was also introduced, but was never very effective.[12] The primary detection method remained the naked (but trained!) eye, the mine probe, and the metal detector.

VC counter-countermine methods improved as the war progressed. Like the Germans and Japanese before them, they used deceit and countermeasures to thwart detection. One technique was to spread metal fragments, slowing metal detector teams. Another was to dig empty holes, wait until Americans had checked and filled them, and then bury mines in the cleared holes to strike the next unit. Like insurgents in Iraq in the twenty-first century, the VC also tunneled under finished roads and buried large AT mines. They even developed a technique to fool the eye, using a mainstay Vietnamese food crop. When scanning a road or path for mines, one of the signs American soldiers are trained to look for is dishing, as the loose soil settling over a fresh hole creates a small concavity. To prevent this, the VC would place a small handful of rice over the mine before replacing the soil. As the rice absorbed moisture from the dirt, it would expand and prevent dishing.[13]

The psychological effects of the enemy's aggressive use of offensive mine warfare spurred further countermine innovation. The mounting alarm of American soldiers led them to take some unusual steps to protect themselves. Foot soldiers would laboriously cut through thick bush instead of risk using the much quicker, established paths. Crews in armored vehicles, especially armored personnel carriers, which were considered more vulnerable to mines than tanks, wore flak vests and helmets even inside their vehicles. Many soldiers chose to ride on top of their vehicles when possible, in the belief that it was better to be thrown clear in a blast then blow up or possibly burn to

death inside. Crewmembers also lined the floors of their vehicles with sandbags to prevent or lessen blast effects. Some were so enthusiastic in this endeavor that there were reports of M113 transmissions breaking due to overloading from the quantity of sandbags.[14] Like route clearance, this technique would be reused decades later in Iraq, leading to frequent maintenance problems in the vehicle fleet.

Another landmine mitigation technique was to prevent them from being laid in the first place. Americans began aggressive patrolling in frequently-mined areas and set up ambushes and a new device, ground sensors, to catch VC placing mines.[15] Artillery bombardment of landing zones (LZs) was used as well in an attempt to detonate mines before an air assault. These were not merely to detonate landmines on the LZ, which threated troops as the disembarked their aircraft. The bombardment was also to detonate perhaps the only significant technological innovation by the VC during the war: the anti-helicopter mine.[16]

The anti-helicopter mine was the VC attempt to counter what was perhaps the most important Allied asset, which allowed Allies to strike anywhere at will and with no warning. Most of these were improvised from existing mines, initiated by pressure or command. In one innovation, one or more pressure mines were covered with a sheet of metal on an LZ. When the helicopter came in to land, the pressure from the prop wash would force the sheet down, functioning the pressure fuzes and detonating the mines. Another case were pull-fuzed mines, commonly used to booby trap trails with tripwires, but in this instance the wire was attached to a tree branch. When the prop wash of a helicopter bent the branch upon approach to the LZ, the wire would pull and detonate the mine.[17]

Used more frequently and to greater success, VC used command-initiated antihelicopter mines. The LZ would be mined, either at ground level with directional (Claymore-type) mines pointed upward, or mounted several feet above the ground, and detonated by a hidden VC triggerman as the helicopter approached the LZ. In a particularly devious trick, the VC would sometimes fashion human-shaped dummies from logs and put them in locations visible from the air. Helicopter pilots, upon spotting the dummies, would descend the aircraft, hoping to rescue one of the many missing in action soldiers, whereupon the VC would detonate a mine hidden in tree branches nearby.[18]

These new anti-helicopter mines (in truth, simply extant landmines modified slightly to target helicopter operations) proved effective enough that many units began using the aforementioned technique of preparing LZs with heavy artillery bombardment before air assaults. Instantaneous fuzes were used in the projectiles, detonating them slightly above the ground rather than on it, minimizing creation of craters and debris which might damage the aircraft. This technique was successful in ridding LZs of anti-helicopter and AP mines. The drawback was that the preparatory fire eliminated the element of surprise.[19]

Americans' own mine use developed in a new direction during the Vietnam War. The directional fragmentation mine had been invented after the Korean War as a response to the human wave tactic employed by the North Koreans. It consisted of a curved or convex charge which, when detonated, propelled fragmentation or other projectiles in a large arc. Hopefully this would fell large numbers of charging enemy at once. The

Claymore is the most famous of these directional mines, and Vietnam was their proving ground.

Another development was the improvement of the air-delivered landmine. This had been used to a small extent as far back as World War II. It had also been embraced by the Allies during the Korean War, up to personal approval by Douglas MacArthur. The new air-dropped mines in Vietnam were used in an attempt to render enemy congregation areas and infiltration routes, such as the infamous Ho Chi Minh trail, hazardous for extended periods of time. The three main types dropped by American aircraft were the Wide Area Antipersonnel Mine (WAAPM), the Dragontooth, and the Gravel mine. The WAAPM was a spherical mine, armed by spin, which shot out tripwires after impact with the ground. When the wires were disturbed, the mine detonated and sprayed the surrounding 60 meters with metal pellets. There were two versions, one which simply detonated and another which was a bounding mine. The bounding version exploded at waist height, wounding but not killing its victim—thereby tying up additional soldiers to assist the wounded. The WAAPM was notable in that it feature a self-inerting feature that rendered the mine safe after a preset time, usually in about a month. Like the M-43s in the Korean War, WAAPMs were released by the hundreds via dispenser, meaning only a few planes could saturate an area with thousands of the mines in a single pass.[20]

The Dragontooth, so-called for its toothed W shape, was intended to be an AT mine. Its angled vanes caused it to drift in the air, which along with the other thousands of mines from the same dispenser created a large dispersal area. However, it weighed less than an ounce, and functioned better as an AP mine. The Gravel mine was another

intended AT mine, which like the Dragontooth was not as effective as hoped. Again, its small size meant it was more likely to blow off a foot than damage a vehicle. Its peculiar movements as it fell from its dispenser resembled that of a falling leaf, leading the Vietnamese to call it the leaf mine. Like the WAAPM, it could be set to self-inert.[21]

The use of air-delivered landmines added to a new controversy growing during the 1960s and 1970s over the use of landmines in warfare. Many centuries before, Francis Markan had worried about fords being rendered permanently unusable due to caltrops. Now, many skeptics questioned the long-term implications of "seeding wide areas with air dropped explosive devices designed to kill anyone who ventures into their neighborhood," and also fretted about a landmine arms race with the Soviets.[22] Though the military lessened their use after deciding air-delivered mines were not reliably effective, the issue contributed to the controversy.[23]

The military updated its doctrine or landmine guidance in several ways during the Vietnam War. This was largely procedural guidance, such as lining vehicle floors with sandbags or hacking through jungle rather than following paths. Armor units altered their driving formations to avoid the bottlenecks that resulted from traveling single file if a vehicle was disabled. Units were advised to vary their movement routines, since the VC often quickly took advantage once tired and complacent troops began to fall into a pattern.[24] The Combined Intelligence Center-Vietnam was responsible for collecting and publishing many of these techniques and what future generations of soldiers would call lessons learned.

Other doctrine was updated as well. A Marine Corps manual discussed countermine techniques such as the civilian informant reward program, and advised

commanders to beware of sudden drops in civilian traffic as an indicator of landmines.[25] Another guideline adopted, after analysis revealed that mine casualties increased later in the day, was to rotate fresh troops to the lead positions. This reduced fatigue, which was vital since, according to one post-war study, over two-thirds of mine detection was done by sight. (This compared with a little over a quarter of mines detected by detonation, and less than 2 percent each by mine detectors, dogs, and informers.)[26]

All told, the Vietnam War was the deadliest war to date, in terms of landmine deaths as percentage of total American casualties. According to some estimates, landmines killed upwards of 11 percent of Americans in Vietnam. In keeping with the trends of World War II and the Korean War, landmines were also accountable for the vast majority of vehicle kills. As many as 70 percent of vehicle losses in Vietnam were due to landmines.[27] The comparatively high number of landmine deaths and vehicle kills were due to the unconventional, and decidedly offensive, use of landmine warfare by the VC during the war. The VC recognized early in the war that they could not compete with America and its allies in terms of air and fire support. Though supplied with some heavy artillery by other Communist allies, North Vietnam simply did not measure up to the United States in that avenue, and had no air support to speak of. Landmines allowed the VC to level the playing field somewhat. Landmine warfare was a way for David to strike at Goliath.

Over and over again, American generals and leaders throughout history have changed their views on landmines. Douglas MacArthur himself approved air-delivered landmines, when the fight in Korea became desperate, even though as a younger officer his writings indicate that he found the idea morally wrong. When the struggle escalates to

the existential level, gloves tend to come off and landmines are used onece more. Prohibitions against certain styles of landmine warfare tend to fall by the wayside. In Vietnam, the Americans simply found themselves on the opposite side: for American soldiers, the war was limited and passing. For the Vietnamese Communists, it was existential. America was Goliath; the North Vietnamese, or VC, were David. For them, unrestricted landmine warfare, therefore, was perfectly acceptable.

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[1] LTG John H. Hay, *Vietnam Studies: Tactical and Material Innovations* (Washington, DC: Department of the Army, 1974), 131.

[2] Croll, 103.

[3] Frank Frost, *Australia's War in Vietnam* (Sydney, Australia: Allen and Unwin, 1987), 95.

[4] Ibid.

[5] Ibid., 95-97.

[6] Croll, 104.

[7] Donn A. Starry, *Mounted Combat in Vietnam* (Washington, DC: Department of the Army, 1977), 79.

[8] Hay, 131.

[9] Center for Army Lessons Learned, CALL Handbook 03-31, *Route Clearance* (Ft. Leavenworth, KS: Center for Army Lessons Learned, 2003).

[10] Starry, 82.

[11] Robert Lubow quoted in Arthur H. Westing, *Explosive Remnants of War* (London: Taylor and Francis, for SIPRI, 1985), 73-74.

[12] Croll, 105.

[13] Ibid.

[14] Westing, 81.

[15] Croll, 105.

[16] Youngblood, *The Development of Landmine Warfare: A Most Murderous and Barbarous Conduct*, 155.

[17] Youngblood, 155; Hay, 10; Combined Intelligence Center-Vietnam, Order of Battle Study ST 67-032, *VC Anti-Heliborne Operations* (Vietnam: Combined Inelligence Center-Vietnam 1967), 5-6.

[18] Ibid.

[19] Ibid.

[20] Eric Prokosch, *The Simple Art of Murder: Antipersonnel Weapons and Their Developers* (Philadelphia, PA: NARMIC, 1972), 54-59.

[21] Ibid.

[22] U.S. Congress, Senate, Electronic Battlefield Committee of the Preparedness Investigating Subcommittee of the Committee on Armed Services, *Investigation into Electronic Battlefield Program*, 92nd Cong., 1st sess., July 13, 1970, accessed 7 March 2015, http://babel.hathitrust.org/cgi/pt?id=uc1.$b643957;view=1up;seq=5, 23833-23834.

[23] MAJ Philip D. Cain, Contemporary Historical Examination of Current Operations Southeast Asia Report, "IGLOO WHITE: July 1968-December 1969" Headquarters, Department of the Air Force, 1970, The Vietnam Center and Archive, Texas Tech University, 23 November 2012, accessed 3 July 2015, http://www.vietnam.ttu.edu/virtualarchive/items.php?item=F031100160005, 2.

[24] Starry, 85-87; United States Marine Corps, *Professional Knowledge Gained from Operational Experience in Vietnam, 1967* (Washington, DC: Department of the Navy, 1989), 350-352.

[25] United States Marine Corps, *Professional Knowledge Gained from Operational Experience in Vietnam, 1965-66* (Washington, DC: Department of the Navy, 1989), 286-87.

[26] Julian J. Ewell and Ira A. Hunt, *Vietnam Studies: Sharpening the Edge: The Use of Analysis to Reinforce Military Judgment* (Washington, DC: Department of the Army, 1974), 138-141.

[27] BDM Corporation, *A Study of Strategic Lessons Learned in Vietnam*, vol. 6, *Conduct of the War*, book 2 (Alexandria, VA: Defense Logistics Agency, 1981), 16-25.

CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

Plenty of Davids

Some revelations about landmines are not merely interesting but also inform conclusions about the impact their use has had on American military practice and doctrine through the years. Early in the country's history, improvised landmines were used during the Seminole War as a means for a desperate defender to hurt an attacker. Though they were not particularly effective in that engagement, this would become a common thread winding its way through the history of landmine use by the United States. Landmines allow David to fight Goliath. For that reason, they have been used frequently even when such use has been considered ungentlemanly or immoral. They have been employed in ways specifically forbidden by written doctrine. Generals and other leaders have often changed their views on landmines when the character of the conflict changes. They have changed their opinions because erstwhile comrades are now foes, as when Union General Barry appeared to reverse his assessment of landmines and of their great innovator, Confederate General Gabriel Rains. They have also altered previous formal doctrine they themselves wrote because their situation is now desperate, as when General Douglas MacArthur authorized air-dropped mines in Korea, directly contradicting a manual written by Lieutenant Douglas MacArthur decades prior.

Landmines also carry an inordinate amount of dread about them. This might be because they are so efficient. Though they started out as improvised and therefore not so effective, landmine warfare using manufactured mines employed with tactical forethought often produced kills at numbers which outweighed all other weapon systems

combined. By Vietnam, more than two-thirds of American vehicles were destroyed by AT landmines. Though AP mines were much less likely to kill outright, the terror they instilled was hardly less. AP mines were often deliberately designed and employed to maim and wound, both to take more soldiers out of the fight and to act as a psychological weapon.

To illustrate the amount of sheer terror landmines cause, and the frustration that commanders feel at the difficulties detecting mines, the example of Vietnam is particularly helpful. The most powerful military in human history was so desperate to reduce landmine deaths and wounds that it radically altered its doctrine and began to ignore one of the core principle of warfare—the element of surprise. American leaders were willing to completely forego surprise, an element of warfare so basic that it predates written history, by blanketing LZs with preparatory fire. In effect, American commanders ceded the initiative to the enemy before the first soldier stepped off the Huey.

The study of landmines is still important even as the United States moves to remove landmines from its arsenal and, ideally, someday sign the Ottawa Convention. A weapon system and style of warfare does not cease to merit study simply because it has fallen from use. Urban warfare still merits intense study, as the United States cannot expect to continue to fight enemies massed in rural areas. Nuclear warfare should still be studied as it remains a real threat even after years of gradual disarmament. Similarly, landmines should continue to be a subject of study and analysis by American military leaders.

The battlefields of the future will not have been scoured clean of landmines left over from past conflicts, even if all current belligerents agree not to use landmine

warfare. Explosive Remnants of War will always be a danger in areas that have seen combat engagements. Many of these remnants will be landmines, threatening not only uniformed allies but innocent civilians. The U.S. military, if only to counteract those remnants it may encounter in future operations, must continue to analyze, study, and train for landmine warfare.

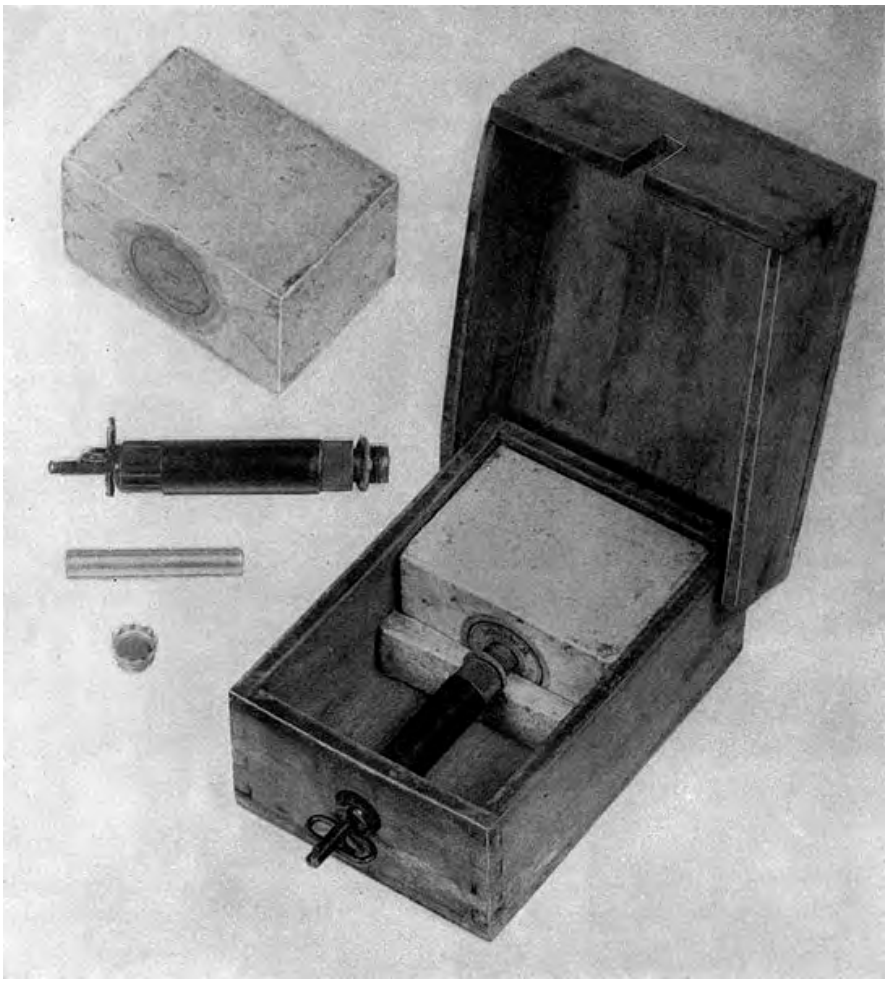
Considerations of landmine use exist above, and perhaps much more important than, the strictly tactical. The political and diplomatic impact of landmine warfare on national strategy cannot be ignored. This is true in regard to enemy activity, but also in regard to that of allies in future coalitions. There are many nations which are not signatory to landmine bans and other treaties. In future multinational coalitions, some partner nations will still possess landmines in their arsenals. They may even employ them, particularly if they perceive their situation to be desperate. Planners and leaders must consider this. Political and diplomatic bad will which adhere to those nations due to use of landmine warfare is likely to adhere to the United States and the coalition writ large.

The practice and doctrine of American landmine warfare have grown fitfully. There were rapid surges of development and innovation which characterized landmine warfare in each conflict addressed in this study. Sometimes technical innovation would far outpace official employment guidance, such as when desperate frontline soldiers in the American Civil War and World War I improvised mines to counter new enemy tactics. At other times, doctrine would shift more radically than the technology, as when MacArthur reversed policy on air-dropped mines.

The haphazard evolution of American landmine warfare also reflected the different nature of America's wars. AT landmines did not rapidly develop until the advent of large-scale armored warfare. Directional fragmentation AP mines, such as the Claymore, only appeared after American soldiers began dealing with mass human wave assaults. Anti-helicopter landmines, and the dramatic shift to shelling LZs prior to an assault, were the result of an enemy improvising his own landmines to counter helicopter warfare. In these and other cases, the practice, the policy, or both, had to quickly and haphazardly adapt to new conditions.

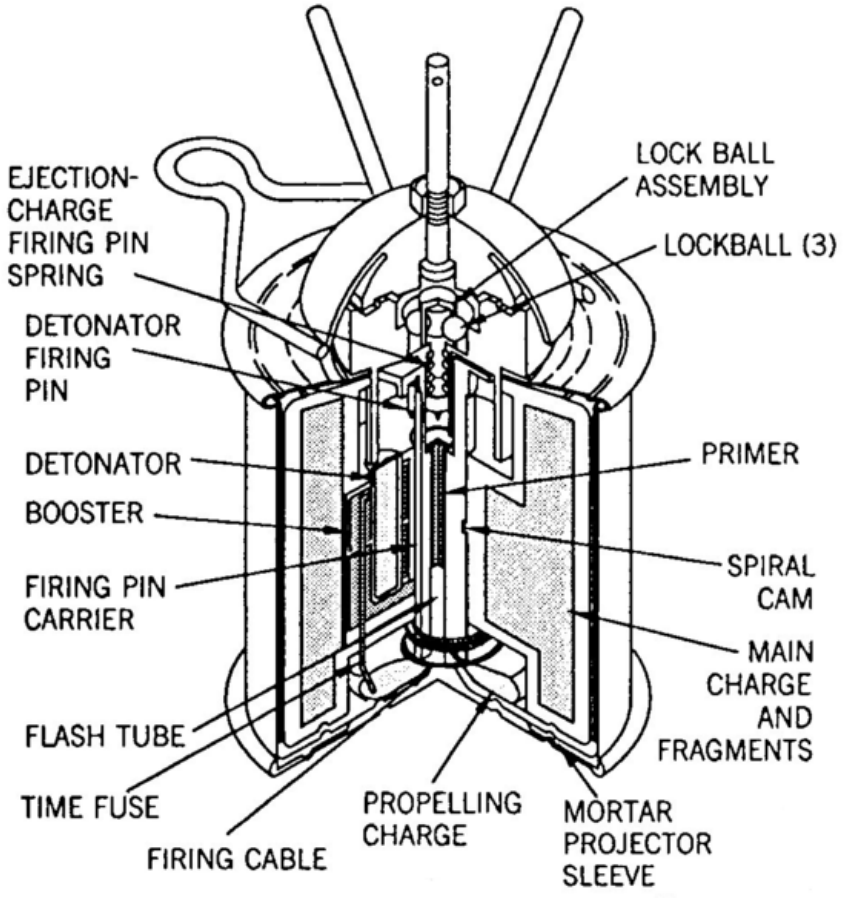
Landmine warfare generates a disproportionate amount of political and diplomatic attention, and causes passionate debate even among leaders in the same military. It strikes such terror into the hearts of soldiers that it makes them consider abandoning strategies which have contributed to battle for thousands of years. Landmines are also a weapon of choice for David to fight Goliath. The future operational environment for America may include a wide range of non-state actors, or take place in undeveloped countries. A Goliath cannot afford in his arrogance to ignore the study of slings. For the United States, there are plenty of Davids in the future.

ILLUSTRATIONS



The German Schu Mine

Source: Wikimedia Commons, “German Schu Mine,” Wikimedia, accessed 21 April 2015, https://commons.wikimedia.org/wiki/File:German_-_Schu-Mine_with_Z.Z._42_igniter.jpg.



An Italian Valmara 59 Bounding Fragmentation Landmine

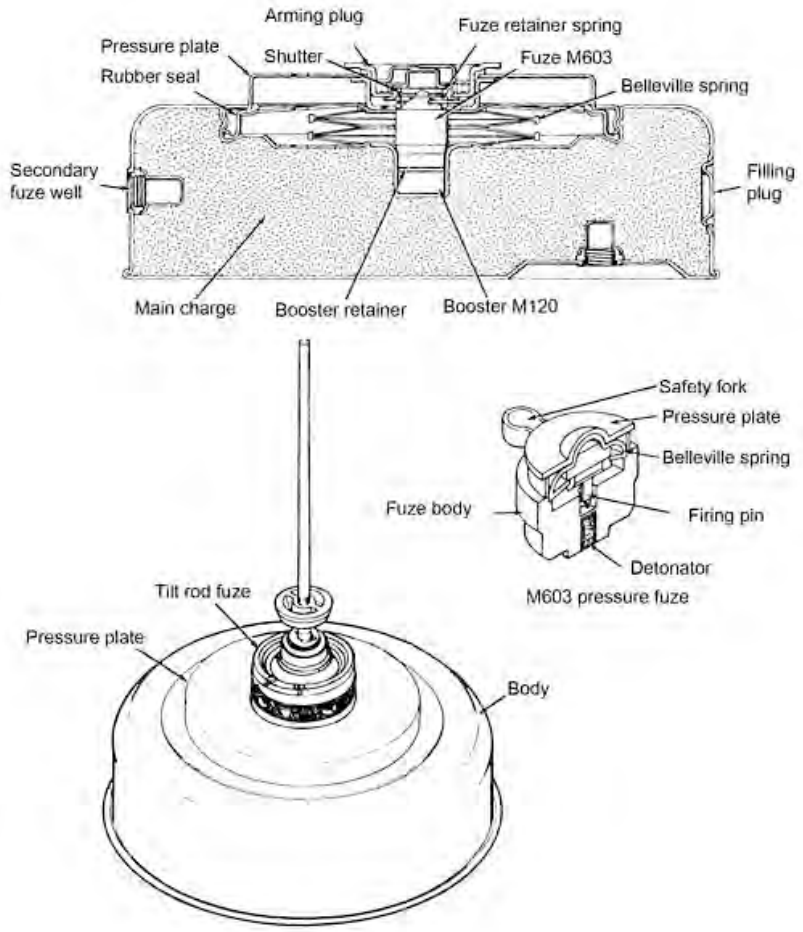
Source: Wikimedia Commons, "Italian Valmara 59 Mine," Wikimedia, accessed 21 April 2015, https://commons.wikimedia.org/wiki/File:Valmara_59_mine_cutaway.png.

Example of L9 Bar Mine Designed to Maximize Susceptibility by Tracked Vehicles

Source: Wikimedia Commons, “L9 Bar Mine,” Wikimedia, accessed 21 April 2015, https://commons.wikimedia.org/wiki/File:L9_Bar_mine.jpg.

Photograph of Scorpion Mine-clearance Device Affixed to Tanks

Source: Wikimedia Commons, “British Army in North Africa, 1942,” Wikimedia, accessed 21 April 2015, https://commons.wikimedia.org/wiki/File:The_British_Army_in_North_Africa_1942_E19019.jpg.



Example of AT Mine with Tilt Rod Attached

Source: Wikimedia Commons, "M15 Mine," Wikimedia, accessed 21 April 2015, https://commons.wikimedia.org/wiki/File:M15_mine_diagram.jpg.

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